APPENDIX H: Methodology and Adjustments to Approaches Used to Estimate Nitrous Oxide Emissions from Mobile Sources

This appendix presents methodology and country-specific approaches that EPA used to estimate N_2O emissions from mobile sources. To estimate emissions of N_2O from mobile sources, EPA estimated fuel consumption for each country, assigned fuel consumption to different categories of vehicles, and then applied the *Revised 1996 IPCC Guidelines* emission factors by vehicle type. The data sources and methodology are described below.

Historical Fossil Fuel Consumption Data

IEA (IEA, 1997b) reported transport-related fuel consumption for road transport and non-road transport for all countries for 1995. The data are further divided by fuel-type, including gasoline and diesel for road vehicles, and coal, oil, natural gas, and aviation fuel for other forms of transport.

Road Fleet Composition

The IPCC emission factors are technology-specific, consequently, EPA needed to assign the fuel consumption data to different vehicles on the basis of the fleet composition in each country, and also the distance traveled by each vehicle type. For road fleet composition, EPA divided each country's road fleet into gasoline and diesel vehicles. The category of gasoline vehicles includes passenger cars, trucks, or motorcycles, and diesel vehicles include passenger cars and trucks. For 1990 and 1995, EPA used the American Automobile Manufacturers Association total vehicle registration data that is assembled for each country (AAMA, 1998). To estimate the size of the gas and diesel vehicle fleets, total vehicle registrations for each country were disaggregated according to the share of gasoline versus diesel car production in major car producing countries (AAMA, 1998). Japan's production breakdown was applied to Japan, Australia and New Zealand. United Kingdom's production breakdown was applied to all of Western Europe, Eastern Europe and Russia. Canada's fleet characteristics were based on default national values (EPA, 1993b). Motorcycle population percentages were applied across all countries similarly, using the EPA assumption that motorcycles are 0.5 percent of the passenger car population. (EPA, 1993b).

Fuel Consumption by Type

Using the fleet composition for each country as determined from the steps above, EPA estimated how much of each fuel type was consumed by each road transport category and sub-category. To weight the shares of gasoline and diesel consumed by heavy-duty vehicles and light-duty vehicles, EPA used the US Federal Highway Administration (FWHA) ratio of vehicle miles traveled by each vehicle type. The FWHA estimated that heavy-duty vehicles travel 2.3 miles for each mile traveled by a light-duty vehicle.

Projected Activity Data

EPA projected fuel consumption by fuel type and transport mode.

- Growth Rates: For both road and non-road transport modes, growth rates for fuel consumption for each country (based on regional estimates) were taken from Schafer and Victor (1997). For road transport, average annual growth rates from Schafer and Victor are based upon projected increases in

personal income in industrialized, transitioning, and developing countries, using the historical precedent that rising income leads to increased demand for mobility. Aircraft use was assumed to grow at the same rate as that used for road transport, based upon the idea that personal income growth affects the use of this travel mode in a manner that is similar to road transportation.

- These growth rates were applied to 1995 baseline consumption estimates to get 2000, 2005, and 2010 consumption by fuel type and transport mode.

Emissions Factors

For non-road transport, Tier 1 IPCC emission factors were assembled by transport mode. For road transport, emissions factors were determined as follows:

- Technology Usage: Since N_2O emission factors are highly dependent on pollution-abatement technology, EPA needed to estimate the types of catalytic converters used in each country's vehicle fleet. Six types of model fleets were developed to account for different patterns of catalyst usage. The technology options considered included early three-way catalysts, advanced three-way catalysts, oxidation catalysts, non-catalysts, uncontrolled and low-emitting vehicles (LEV).

- Projected Technology Use: Countries were divided into these technology groups based on type of technology currently in place, type of technology planned for or anticipated, region of the world, and the relative availability of leaded gasoline. This grouping was supported by information in *Motor Vehicle Emission Regulations and Fuel Specifications in Europe and the United States: 1995 Update* (CONCAWE, 1995). Countries with similar vehicle emissions legislation and available fuel types were grouped together.

- Emissions factors by technology, transport mode, and fuel type: IPCC emissions factors by technology, transport mode, and fuel type were assembled and used for nearly every country except Australia, Canada, Japan, New Zealand and Sweden (IPCC, 1996). These countries have advanced emissions control programs similar to the U.S., and therefore, the most recent US emissions factors were used (EPA, 1999b).

- Technology adjustment: For each country, the emissions factors were weighted by the technology composition assumed for the appropriate model fleet for each year.

Historical and Projected Emissions

For non-road transport, fuel consumption over time was multiplied by the IPCC emissions factors assembled by transport mode and fuel type. For road transport, the technology-adjusted emissions factors were multiplied by the fuel consumption projections by fuel type and transport mode for each year.